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TITLE: ELECTROCONDUCTIVE **RUBBER** COMPOSITION AND ELECTROCONDUCTIVE **RUBBER** ROLLER AND ELECTROCONDUCTIVE **RUBBER** BELT USING THE SAME ELECTROCONDUCTIVE **RUBBER** COMPOSITION

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ABSTRACT:

PROBLEM TO BE SOLVED: To reduce the volume resistivity value of an electroconductive **rubber** composition used for an electroconductive **rubber** roller, etc., reduce the compression set and eliminate even fouling of a photoreceptor.

SOLUTION: This electroconductive **rubber** composition is obtained by mixing an epichlorohydrin **rubber with an ethylene oxide-propylene oxide**-allyl **glycidyl**

ether terpolymer having 50-95 mol%/1-49 mol%/1-10 mol% copolymerization ratio of the **ethylene oxide/propylene oxide**/allyl **glycidyl** ether and &ge;10,000 number-average molecular weight in &ge;0.01 and &le;4.00 weight ratio based on the epiclorohydrin **rubber**.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is used for a conductive rubber constituent list about the conductive rubber roller which used this conductive rubber constituent, and a conductive rubber belt effective in electrification rollers, such as a copy machine and a printer, a developing roller, a toner feed roller, an imprint roller, an imprint belt, etc.
[0002]
[Description of the Prior Art] In the electrification roller used for this kind of copy machine, a printer, etc., a developing roller, a toner feed roller, an imprint roller, and an imprint belt, it is necessary to give the moderate stable electric resistance value. Conventionally, there are an approach using the electronic conductive rubber which blended conductive bulking agents, such as powder of a metallic oxide and carbon black, into rubber, and an approach using ion conductive rubber, such as polyurethane rubber, acrylonitrile-butadiene rubber (NBR), and epichlorohydrin rubber, as an approach of giving conductivity to this kind of a roller and a belt.
[0003] In the conductive roller or the conductive belt using the electronic conductive rubber which blended the above-mentioned conductive bulking agent, there is a problem which the electric resistance value does not equip with the fixed electric resistance value depending on applied voltage. Since there is a field where the correlation stabilized between the addition of carbon black and the volume resistivity of rubber is not seen, and an electric resistance value changes with slight change of the addition of carbon black rapidly when carbon black is especially used as a conductive bulking agent, control of an electric resistance value becomes very difficult. In addition, it is converted by the constant formula so that the roller electric resistance value after fabricating on the volume resistivity and the roller of a conductive rubber ingredient may be mentioned later, and it changes with the configurations of a roller (or belt).
[0004] Moreover, since it is hard to distribute a conductive bulking agent to homogeneity in rubber, there is also a problem that an electric resistance value has dispersion in the hoop direction and the cross direction of a roller or a belt. Furthermore, even if dispersion with a big electric resistance value is reduced, dispersion in the electric resistance value in the very small range of mum order still exists. It is in the inclination for the direction of the ion conductive rubber instead of electronic conductive rubber to be fond, and to be used especially in recently [of the technique of high-definition-izing, such as digitization and colorization, / remarkable] from this.
[0005] On the other hand, as an electric conduction agent of the above-mentioned ion conductive rubber, there are conductive oligomer and a conductive plasticizer (for all, Mn is 10000 or less) including polyether structures, such as polyethylene oxide. However, in the ion conductive rubber using the above-mentioned electric conduction agent, there is a problem which is easy to pollute a photo conductor.
[0006] Although there is also a method of using NBR and polyurethane rubber in addition to the above, only the resistance more than 109.6-ohmcm (the electric resistance value of a roller is 108.2ohms) is

acquired, and a volume resistivity value cannot respond to what comparatively low electric resistance values, such as a thing for colors, are required as also with an imprint belt or an imprint roller.
[0007] Therefore, it is common to the above-mentioned application, some electrification rollers, a developing roller, and a toner feed roller to blend epichlorohydrin rubber with the ingredient of independent or others, and to use it, and various proposals are made.
[0008] In JP,2000-63656,A, it is a half-conductivity ingredient containing a 40-10 mol % and 60-90 mol [of ethyleneoxides] % and 0-10 mol [of allyl glycidyl ether] % [of epichlorohydrin] ether system copolymer, and the half-conductivity ingredient with the low volume resistivity value is proposed. Moreover, in patent No. 2647117, the developing roller aiming at the outstanding rubber elasticity maintenance in low temperature using the rubber which blended 0-15 mol % of propylene oxide independent, or propylene oxide and 30-98 mol % and 0-60 mol [of epichlorohydrin] % and partial saturation epoxide of ethyleneoxides is proposed, and allyl glycidyl ether is used as an example of partial saturation epoxide.
[0009]
[Problem(s) to be Solved by the Invention] When epichlorohydrin rubber is used independently, only the resistance more than 108.1-ohmcm (it is 106.8ohms at the electric resistance value of a roller) can be acquired with a volume resistivity value. Although the epichlorohydrin rubber which gathered the polymerization ratio of ethyleneoxide is developed and about [107.5ohmcm] (500V) low resistance can be realized with a volume resistivity value in recent years, since compression set becomes large, on the other hand, there is a problem of not being suitable in practical use.
[0010] If ethyleneoxide / allyl glycidyl ether / propylene oxide copolymer is blended with the epichlorohydrin rubber marketed by the epichlorohydrin rubber or the present usual ones indicated by said official report, while being able to hold down an electric resistance value low, the rubber roller which suppresses generating of bleeding and does not pollute a photo conductor is producible. That is, bleeding and photo conductor contamination are made hard to stabilize many ion by content of ethyleneoxide, to realize low resistance, to suppress crystallization by copolymerization of propylene oxide, and to cause by copolymerization of allyl glycidyl ether. However, when the rate of a compounding ratio of the above-mentioned ethyleneoxide / propylene oxide / allyl-glycidyl-ether copolymer was not proper, this invention person found out by experiment that there was a problem to which compression set becomes large and the dimensional change when considering as a roller etc. becomes large.
[0011] Since epichlorohydrin rubber with the high ethyleneoxide content which stabilizes ion is used for the half-conductivity ingredient of the indication to said JP,2000-63656,A, it can make a volume resistivity value low, but when it is used independently, has the fault that compression set becomes large and the dimensional change when considering as a roller etc. becomes large, and has the problem that a degree of hardness rises too much and it is not suitable for practical use. Furthermore, when blending other polymers, if the class and loadings (ratio) are not made proper, an electric resistance value rises and there is a problem of not being suitable for practical use. When similarly the rate of a compounding ratio of ethyleneoxide / propylene oxide / allyl-glycidyl-ether copolymer is not specified and it is not blended [above-mentioned patent / No. 2647117] proper in the developing roller of an indication, compression set and a degree of hardness become large, and there is a problem that it is not suitable for practical use like the above.
[0012] When it was made in view of the above-mentioned problem and blends ethyleneoxide / propylene oxide / allyl-glycidyl-ether copolymer with epichlorohydrin rubber, this invention Set up this rate of a compounding ratio proper, and a volume resistivity value is lower than conventional ion conductive rubber therefore. And compression set makes it the technical problem to offer what photo conductor contamination does not have, either and is especially used for a small top effectively as the conductive rubber roller or the conductive rubber belt for colors.
[0013]
[Means for Solving the Problem] the ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object whose number average molecular weight Mn the copolymerization ratio of this

invention of ethyleneoxide / propylene oxide / allyl glycidyl ether is 50-95-mol %/1 - 49-mol %/1 - ten-mol %, and is 10000 or more in order to solve the above-mentioned technical problem -- epichlorohydrin rubber -- receiving -- a weight ratio -- the conductive rubber constituent characterized by mixing or less [0.01 or more] by 4.00 is offered.

[0014] As mentioned above, the mutual copolymerization ratio of an ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object was specified, and this ternary polymerization object and epichlorohydrin rubber are blended at a specific rate, and thereby, by conventional ion conductive rubber, by the low resistance with the practicality which was not able to be realized, compression set is small, and at the conductive rubber constituent of this invention, when it considers as a roller or a belt, what has good dimensional stability can be obtained.

[0015] It is based on the following reasons that the copolymerization ratio of the above-mentioned ethyleneoxide (it is also called Following EO) / propylene oxide (it is also called Following PO) / allyl glycidyl ether (it is also called Following AGE) is made into 50-95-mol %/1 - 49-mol %/1 - ten-mol %.

[0016] It is because the oxonium-ion metallurgy group cations in a polymer (for example, nickel ion contained in a polymer antioxidant) are stabilized in an ethyleneoxide unit and carried by the segmental motion of the chain of the part among a conductive rubber constituent that conductivity is demonstrated. Therefore, the one where the ratio of an ethyleneoxide unit is higher can stabilize many ion, and is considered that it can demonstrate low resistance-ization. However, if the ratio of ethyleneoxide is gathered too much, since crystallization of ethyleneoxide will take place and the segmental motion of a chain will be barred, volume resistivity goes up conversely. Propylene oxide is copolymerized in order to control crystallization by this ethyleneoxide.

[0017] As for the conductive rubber constituent of this invention, it is desirable to make the volume resistivity value into the range of 107.0-ohmcm - 107.9-ohmcm. This is difficult to realize a conductive rubber constituent with a volume resistivity value smaller than 107.0-ohmcm by ion conductive rubber, and it is because it depends on carbon electric conduction isoelectronic conductive resin and does not spread on it, and when it was larger than 107.9-ohmcm and it considers as a roller or a belt, it is because there is a problem of effectiveness, such as an imprint, and electrification, toner supply, falling and stopping being suitable for practical use. in addition, the Measuring condition of a volume resistivity value -- the constant temperature of 55% of 23-degree-C relative humidity -- it is referred to as applied-voltage 500V under the constant humidity condition.

[0018] The mutual copolymerization ratio of the above-mentioned ethyleneoxide, propylene oxide, and the ternary polymerization object of allyl glycidyl ether was set up, and the weight rate of a polymer and epichlorohydrin rubber of this 3 yuan is specified so that it may become the above-mentioned volume resistivity value. Less than [50 mol %], if propylene oxide exceeds 49-mol %, it will become inadequate stabilizing [of ion] ethyleneoxide, and a volume resistivity value becomes larger than 107.9-ohmcm. On the other hand, while ethyleneoxide exceeds 95-mol %, there is a problem which volume resistivity goes up that propylene oxide is less than [1 mol %] too much, and becomes larger than 107.9-ohmcm. Moreover, when a degree of hardness rises too much by crystallization also in physical properties and it uses as a roller or a belt, there is a problem which stops being suitable for practical use.

[0019] While bridge formation is made possible, and it is [bleeding or photo conductor contamination] lifting-hard and carrying out them by this by copolymerizing the above-mentioned allyl glycidyl ether, rubber elasticity is given and physical properties are raised. Moreover, from this allyl-glycidyl-ether unit itself obtaining free volume as a side chain, the above-mentioned crystallization can be controlled further and it is based on having found out that low resistance-ization which therefore is not in the former was realizable. If ten-mol % is exceeded while generating of bleeding or photo conductor contamination becomes easy to take place less than [1 mol %], the number of make [the copolymerization ratio of allyl glycidyl ether / into 1-10 mol %] of the points after vulcanization constructing a bridge will increase, low resistance-ization will not be able to be realized on the contrary, and tensile strength, a fatigue property, flexibility, etc. will get worse.

[0020] Thus, while suppressing crystallization of ethyleneoxide and lowering volume resistivity by copolymerizing allyl glycidyl ether, the double bond between carbon-carbon is introduced by copolymerization of allyl glycidyl ether, and bridge formation with other rubber is enabled. Bleeding and photo conductor contamination can be prevented by carrying out a joint use pons to other rubber. Furthermore, due to a joint use pons with other rubber, since molecular weight is also large and it can carry out, even if the above-mentioned ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object blends a remarkable daily dose, bleeding and photo conductor contamination stop being able to happen easily.

[0021] The number average molecular weight Mn of the above-mentioned ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object is carrying out for preventing bleeding and photo conductor contamination to 10000 or more.

[0022] moreover, the above-mentioned ternary polymerization object -- epichlorohydrin rubber -- receiving -- a weight ratio -- if the above-mentioned weight ratio is smaller than 0.01, because low resistance-ization will not be realized, it mixes or less [0.01 or more] by 4.00, and on the other hand, when the above-mentioned weight ratio is larger than 4.00, it is for degradation to arise in respect of physical properties, such as rubber elasticity, and photo conductor contamination. Specifically, the above-mentioned weight ratio becomes almost fixed between 1.00-4.00, although volume resistivity becomes low uniformly with the increment in a ternary polymerization object about to 0.01 to 1.00. If a weight ratio exceeds 4.00, conversely, volume resistivity will begin to go up, and as described above, photo conductor contamination etc. will arise.

[0023] An epichlorohydrin (it is also called Following EP) simple substance is sufficient as the above-mentioned epichlorohydrin rubber, or duality with epichlorohydrin, ethyleneoxide (EO) or/, and allyl glycidyl ether (AGE) or a ternary polymerization object is sufficient as it. the EO-PO-AGE ternary polymerization whose above-mentioned number average molecular weight Mn is 10000 or more -- the inside of the body -- there is an advantage of realizing a lower electric resistance value, by carrying out copolymerization of EO or/, and AGE also into epichlorohydrin rubber, and mixing both to except. Since volume resistivity becomes lower [direction] that ethyleneoxide is especially included in epichlorohydrin rubber, it is desirable. Moreover, since volume resistivity does not go up since the direction containing allyl glycidyl ether can construct a bridge with sulfur into epichlorohydrin rubber, and photo conductor contamination can be prevented, it is more desirable. The desirable content ratio of EP:EO:AGE in the above-mentioned epichlorohydrin rubber is 10-65 mol %:30-90 mol %:0.5 - ten-mol %, and a still more desirable ratio is EP:EO:AGE=20-45 mol %:50-75 mol %:3 - seven-mol %.

[0024] In addition, when allyl glycidyl ether is not included in epichlorohydrin rubber, it becomes bridge formation using the bridge formation using a peroxide, or chlorine. Although for example, triazine bridge formation, the poly thiol bridge formation, thiourea system bridge formation, etc. are mentioned to bridge formation using chlorine, it is good to construct a bridge with sulfur preferably, from a viewpoint of making volume resistivity low, as described above.

[0025] Volume resistivity can be lowered if acrylonitrile-butadiene rubber (NBR) is mixed below 20 weight sections more than 1 weight section to a total of 100 weight sections of the polymer which consists of an EO-PO-AGE ternary polymerization object and epichlorohydrin rubber. Although this reason is considered to become easy to move ion by NBR, if [than 20 weight sections] more, since own volume resistivity of NBR is high, volume resistivity will go up conversely. Moreover, since the physical properties of a constituent are more excellent and the transportation efficiency of ion also becomes high by mixing of NBR, it is desirable to mix NBR in the above-mentioned amount of range also from the above viewpoint. Moreover, as NBR, the mixture of the amount NBR of macromolecules and liquefied NBR is used especially suitably, and NIPPORU DN223 by Nippon Zeon Co., Ltd. is mentioned to this.

[0026] As a class of accelerator, dibenzothiazyl disulfide and tetramethylthiurammonosulfide are combined and it is still more desirable to increase the quantity of the loadings of sulfur and dibenzothiazyl disulfide (usually about 2 to 5 times of the amount used (1 weight section)). In addition, 2-mercaptobenzothiazole etc. may be used instead of dibenzothiazyl disulfide.

[0027] Moreover, since the blend ratio of an EO-PO-AGE ternary polymerization object is rationalized and the class of accelerator is also rationalized according to sulfur bridge formation in this invention, compression set is small. JIS mentioned later It is desirable that the value of the compression set in the case of the solid test piece by the approach given in K6262 is less than 40%. This is because the dimensional change when becoming a roller becomes large too much and it is not suitable for practical use, when the value of the above-mentioned compression set is 40% or more. Although the difference of how many minutes is produced according to expansion ratio or a foaming gestalt when using as foam especially, it is more desirable that the value of the compression set in this solid condition is 30% or less.

[0028] The conductive rubber constituent of this invention is manufacturing conductive rubber by carrying out melting kneading and vulcanizing the various compounding agents (a vulcanization accelerator, a bulking agent, carrier acid, antioxidant, etc.) blended the above-mentioned ternary polymerization object, epichlorohydrin rubber, a vulcanizing agent, and if needed. Melting kneading can be performed by the usual approach. For example, it is kneading about 2 to 10 minutes at 40 degrees C - 130 degrees C using well-known rubber kneading equipments, such as an opening roll and a direct-vent-system kneading machine.

[0029] As a vulcanization system, since reduction in resistance and low stain resistance are realized, sulfur vulcanization is desirable. Furthermore, when a hydrotalcite is used, it is more desirable from the point of low stain resistance. Vulcanization can also be performed by the usual approach, for example, you may vulcanize in the vulcanizer under steam pressurization, and secondary vulcanization may be performed if needed.

[0030] From the above-mentioned conductive rubber constituent, the conductive rubber roller and the conductive rubber belt are fabricated. Since it has low volume resistivity and excels in the point that compression set is small, since the electric resistance value is low, the conductive rubber constituent of this invention is especially used suitably in the conductive rubber roller using this, when low electric resistance values, such as the imprint roller and electrification roller for colors, a toner feed roller, and a developing roller, are required.

[0031] After being able to create the above-mentioned conductive rubber roller with a conventional method, for example, preforming the above-mentioned conductive rubber constituent (kneading object) in the shape of a tube with a single screw extruder, and vulcanizing 160 degrees C of this preforming article for 10 to 60 minutes, and it inserts rodding and grinds a front face, it can be cut into a necessary dimension and conventionally well-known various approaches, such as considering as a roller, can be used for it. Vulcanizing time is good to decide in quest of optimum cure time amount with the rheometer for a vulcanization trial (example: curelast meter). Moreover, vulcanizing temperature may be gone up and down and set to the above-mentioned temperature if needed.

[0032] Moreover, after the above-mentioned conductive rubber belt extrudes the above-mentioned conductive rubber constituent (kneading object) in the shape of a belt with an extruding press machine and fabricates it, it can perform 160 degrees C and 10 - 60-minute vulcanization, and the conventionally well-known various approaches of creating the body of a belt can be used for it. Vulcanizing temperature may be gone up and down and set to the above-mentioned temperature if needed.

[0033]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained. As for the conductive rubber constituent of this invention, the copolymerization ratio of ethyleneoxide / propylene oxide / allyl glycidyl ether is mixing the ethyleneoxide [whose number average molecular weight Mn it is 50-95 mol %/1 - 49 mol %/1 - ten mol %, and is 10000 or more]-propylene oxide-allyl-glycidyl-ether ternary polymerization object by 4.00 or less heavy or more 0.01 quantitative ratio to epichlorohydrin rubber.

[0034] The copolymerization ratio of epichlorohydrin / ethyleneoxide / allyl glycidyl ether is using the above-mentioned epichlorohydrin rubber as the 10-65-mol %/30 - 90-mol %/0.5 - ten-mol epichlorohydrin rubber [which is %]-ethyleneoxide-allyl-glycidyl-ether ternary polymerization object. moreover, an epichlorohydrin simple substance is sufficient as the above-mentioned epichlorohydrin rubber -- carrying out -- duality with epichlorohydrin, ethyleneoxide, or allyl glycidyl ether -- it is good also as a copolymer.

[0035] After blending various compounding agents a vulcanizing agent and if needed in addition to the above-mentioned rubber constituent, melting kneading is carried out using well-known rubber kneading equipments, such as a direct-vent-system kneading machine. While making low the volume resistivity value of the conductive rubber constituent used for a conductive rubber roller etc. by this, compression set can also be made small and photo conductor contamination can also be lost.

[0036] After preforming the kneading object which performed the above-mentioned vulcanization in the shape of a tube with a single screw extruder, vulcanizing 160 degrees C of this preforming article for 10 to 60 minutes, inserting rodding and grinding a front face, it cuts into a necessary dimension and is considering as the roller for an imprint. As shown in drawing 1 , the conductive rubber roller 1 for the above-mentioned imprint is a cylindrical shape-like, and the axis 2 is inserted in the inner circumference.

[0037] In addition, in this operation gestalt, although the conductive rubber roller was created from the above-mentioned conductive rubber constituent as a roller for an imprint, it cannot be overemphasized that this conductive rubber constituent is used as conductive rubber rollers, such as an electrification roller, a developing roller, and a toner feed roller. Moreover, various foaming agents may be blended with a conductive rubber constituent, and you may use as a foaming roll etc.

[0038] Moreover, as shown in drawing 2 , the conductive rubber belts 3, such as an imprint belt, are created from the conductive rubber constituent. The conductive rubber belt 3 is made a firm-bridging condition by two or more pulleys 4, and supports and conveys the web materials 6, such as paper, by them into the straight-line-like part 5 of the conductive rubber belt 3 top which rotates.

[0039] (Example) About examples 1-5 and the examples 1-5 of a comparison, the following Table 1 and 2 were made to knead and vulcanize the ingredient (combination chemical) which consists of combination of a publication, and the conductive rubber constituent was obtained. Moreover, the solid rubber roller for an imprint was created from the conductive rubber constituent of this example.

[0040]

[Table 1]

[0041]
[Table 2]

配合薬品	薬品詳細（薬品名(=商品名)・メーカー）		実施例1	実施例2	実施例3	実施例4	実施例5
EO-PO-AGE共重合体(EO:PO:AGE=90:4:6,Mn=8万)	ZSN8030	日本ゼオン	10	50	75	47.5	25.0
エピクロルヒドリンゴム(EO:EP:AGE=56:40:4,Mn=14万)	エピクロマーCG102	ダイソー	90	50	25	47.5	0
エピクロルヒドリンゴム(EO:EP:AGE=73:23:4,Mn=13万)	(高EO試作品)	ダイソー	0	0	0	0	75
アクリロニトリルブタジエンゴム　(Mn=19万とMn=5千(2山))	ニッポールDN223	日本ゼオン	0	0	0	5	0
無機充填剤1	軽質炭酸カルシウム	丸尾カルシウム	20	20	20	20	20
合成ハイドロタルサイト	DHT-4A-2	協和化学	2.7	1.5	0.75	1.43	2.25
酸化亜鉛	銀嶺R	東邦亜鉛	5	5	5	5	5
ステアリン酸	4931	ユニケマオーストラリア	1	1	1	1	1
加硫剤1	粉末硫黄	鶴見化学	1.5	1.5	1.5	1.5	1.5
加硫促進剤1	ノクセラーDM	大内新興化学工業	1.5	1.5	1.5	1.5	1.5
加硫促進剤2	ノクセラーTS	大内新興化学工業	0.5	0.5	0.5	0.5	0.5
体積固有抵抗値(@500V)（常用対数値）			7.9	7.4	7.4	7.2	7.3
圧縮永久歪み(ソリッドのゴム試験片による評価) [%]			37	33	30	27	28
感光体汚染試験(ゴムスラブによる評価)			○	○	△	○	○

配合薬品	薬品詳細（薬品名(=商品名)・メーカー）		比較例1	比較例2	比較例3	比較例4	比較例5
EO-PO-AGE共重合体(EO:PO:AGE=90:4:6,Mn=8万)	ZSN8030	日本ゼオン	0	90	100	0	0
エピクロルヒドリンゴム(EO:EP:AGE=56:40:4,Mn=14万)	エピクロマーCG102	ダイソー	100	10	0	0	80
エピクロルヒドリンゴム(EO:EP:AGE=73:23:4,Mn=13万)	(高EO試作品)	ダイソー	0	0	0	100	0
(EO:PO:AGE=70:24:6,Mn=750)	ユニセーフPKA-5011	日本油脂	0	0	0	0	20
アクリロニトリルブタジエンゴム　(Mn=19万とMn=5千(2山))	ニッポールDN223	日本ゼオン	0	0	0	0	0
無機充填剤1	軽質炭酸カルシウム	丸尾カルシウム	20	20	20	20	20
合成ハイドロタルサイト	DHT-4A-2	協和化学	3	0.3	0	3	2.4
酸化亜鉛	銀嶺R	東邦亜鉛	5	5	5	5	5
ステアリン酸	4931	ユニケマオーストラリア	1	1	1	1	1
加硫剤1	粉末硫黄	鶴見化学	1.5	1.5	1.5	1.5	1.5
加硫促進剤1	ノクセラーDM	大内新興化学工業	1.5	1.5	1.5	1.5	1.5
加硫促進剤2	ノクセラーTS	大内新興化学工業	0.5	0.5	0.5	0.5	0.5
体積固有抵抗値(@500V)（常用対数値）			8.2	7.5	7.6	7.4	－
圧縮永久歪み(ソリッドのゴム試験片による評価)〔%〕			32	31	44	49	－
感光体汚染試験(ゴムスラブによる評価)			○	×	×	△	××

[0042] The numeric value of the upper case in each table (up to a vulcanization accelerator) is the weight section. Moreover, in Abbreviation EO, ethyleneoxide and PO express propylene oxide and AGE expresses allyl glycidyl ether. Moreover, with acrylonitrile-butadiene rubber, the thing which made the usual acrylonitrile-butadiene rubber 100 weight section contain liquefied acrylonitrile-butadiene rubber at a rate of 50 weight sections was used among each table. The vulcanization accelerator 1 was made into dibenzothiazyl disulfide, and the vulcanization accelerator 2 was made into tetramethylthiurammonosulfide.

[0043] (An example 1 thru/or example 5) It mixed with the compounding ratio of the above-mentioned convention which shows an EO-PO-AGE ternary polymerization object and epichlorohydrin rubber in Table 1, and the conductive rubber constituent was obtained.

[0044] (The example 1 of a comparison thru/or example 5 of a comparison) As shown in Table 2, only the EO-PO-AGE ternary polymerization object obtained the conductive rubber constituent which only epichlorohydrin rubber becomes with a compounding ratio from which the weight ratio of an EO-PO-AGE ternary polymerization object to epichlorohydrin rubber is set to 9.00.

[0045] The ingredient shown in the above-mentioned table 1 was kneaded with each loadings with the direct-vent-system kneading machine (DS10-40 MWA-S, Made in the Moriyama Factory). The rubber which picked the ribbon from the above-mentioned kneading machine was extruded with the roller head extruder, it fabricated in the shape of a sheet, it was taught to metal mold, optimal time amount press cure was carried out at 160 degrees C, and the vulcanization rubber slab sheet for physical-properties evaluation was created.

[0046] The following property measurement was performed about the conductive rubber constituent of each example created as mentioned above and each example of a comparison. The result is shown in the lower berth of above-mentioned Table 1 and 2.

[0047] (Measurement of a volume resistivity value) the vulcanization rubber slab sheet (130mmx130mmx2mm) created as mentioned above -- creating -- digital ultra-high-resistance microammeter R-8340A by the advanced corporation company -- using -- the constant temperature of 55% of 23-degree-C relative humidity -- as the bottom of a constant humidity condition, and applied-voltage 500V -- JIS Volume-resistivity (volume resistivity value) rhoV (omegacm) of a publication was measured to K6911.

[0048] In addition, in the case of a solid roller with a uniform monolayer, the roller electric resistance R (omega) can be expressed like a degree type.

R (omega) = (rhoV/2pinu) log10 (r1/r2)

rhoV is volume resistivity (ohm-cm) among the above-mentioned formula, nu is roll rubber width of face (cm), r1 is a roll outer diameter (mm), and r2 is a shaft outer diameter (mm). Here, since the dimensions of the roller created in the example and the example of a comparison are r1=15, r2=6, and nu= 21.8, if these values are assigned, they will become like a degree type theoretically.

log10 R (omega) = -2.5 + log10 It rhoV Depends, and if volume resistivity values (omegacm) are 107.2-108.0 (omegacm), with the solid imprint roller of the above-mentioned dimension, the roller electric resistance value R (omega) will be set to 104.7-105.5 (omega). However, in an actual measurement, the numeric value 2.5 in an upper type is set to 1.3-2.0, and the roller electric resistance value R (omega) is set to 105.2-106.7 (omega). In addition, the common-logarithm value of volume resistivity shows to Table 1 and Table 2.

[0049] (Measurement of compression set) It measured in measurement temperature [of 70 degrees C], and measuring-time 24 hours according to the convention of JISK6262 "the permanent-set test method of vulcanized rubber."

[0050] (Photo conductor contamination trial) Laser made from Hewlett Packard Where each vulcanization rubber slab sheet of an example and the example of a comparison is pushed against the photo conductor set to the cartridge (cartridge type C4127X) of a Jet4000 mold laser beam printer, it is kept for one week under 23 degrees C and conditions of 55% of relative humidity. Then, each vulcanization rubber slab sheet was removed from the photo conductor, the above-mentioned printer performed halftone printing using the photo conductor concerned, the dirt existence of printed matter was checked visually, and it evaluated in the following three steps.

O : with [as long as printed matter is seen by the eye] no contamination.

**: Slight contamination (it is satisfactory on the use which can be taken even to extent which the imprinting of less than five sheets does not see and show by the eye contamination)

x: Serious contamination (contamination which looks at printed matter by the eye, and abnormalities understand although five or more sheets are stenciled)

[0051] Drawing 3 is Graf who shows the amount of blends of an EO-PO-AGE copolymer (ZSN8030) and the relation of the common-logarithm value of a volume resistivity value to examples 1-3 and the examples 1-3 of a comparison. It has checked that it will begin to go up 0.01 to about 1.00 conversely if the weight ratio compared with the epichlorohydrin rubber (CG102, EP:EO:AGE=40:56:4) of an EO-PO-AGE ternary polymerization object (ZSN8030) from this Graf becomes almost fixed between 1.00-4.00 and exceeds 4.00 although the volume resistivity value becomes low uniformly with the increment in a ternary polymerization object. From this, it is thought appropriate to mix the above-mentioned ternary polymerization object by the weight ratio of the above-mentioned convention range.
[0052] Drawing 4 is Graf who shows the relation of the common-logarithm value of the amount of NBR blends in an example 2 and an example 4, and a volume resistivity value. It has checked that 1 - 20 weight section, then a low volume resistivity value were [the amount of blends of NBR] realizable from this Graf as mentioned above.
[0053] As shown in Table 1, an example 1 - an example 5 are the conductive rubber constituents which mixed the ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object (EO-PO-AGE copolymer) whose number average molecular weight Mn the copolymerization ratio of ethyleneoxide / propylene oxide / allyl glycidyl ether is 90 mol %/4 mol %/6 mol %, and is 80,000 by the weight ratios 0.11-3.00 to epichlorohydrin rubber. As for the conductive rubber constituent of these examples 1 - an example 5, the volume resistivity value of 107.2-ohmcm - 107.9-ohmcm and compression set was 27% - 37%, and although only the example 3 of evaluation of a photo conductor contamination trial was **, all other examples were O. Thus, it has checked having the outstanding property that an example 1 - an example 5 have a low volume resistivity value, compression set is small, and no photo conductor contamination is almost.
[0054] Since especially the example 5 was using epichlorohydrin rubber with high EO content with the EO-PO-AGE copolymer of a specific copolymerization ratio, the volume resistivity value was 107.3-ohmcm and its volume resistivity was more low compared with the examples 1-3 which used epichlorohydrin rubber with low EO content.
[0055] Moreover, volume resistivity is the lowest, the value is 107.2-ohmcm, and the example 4 which carried out 5 weight sections use of the acrylonitrile-butadiene rubber was more excellent.
[0056] As shown in Table 2 on the other hand, although an EO-PO-AGE copolymer was not used for the example 1 of a comparison but it was a constituent only using epichlorohydrin rubber, the volume resistivity value was as high as 108.2-ohmcm. Although the example 2 of a comparison was the conductive rubber constituent which made the EO-PO-AGE copolymer used in the example the weight ratio 9.00 to epichlorohydrin rubber, and was mixed at a larger rate than the weight ratio 4.00 which is the convention range, it has photo conductor contamination and was not suitable for practical use. Although the example 3 of a comparison was a constituent only using the EO-PO-AGE copolymer used in the example, it had photo conductor contamination, and carries out spec. out and was still more unsuitable. [of compression set]
[0057] Although the example 4 of a comparison was a constituent only using epichlorohydrin rubber with high EO content used in the example 5, compression set carried out spec. out, to an unsuitable top, photo conductor contamination evaluation was also ** and it was not so desirable. [of evaluation] The copolymerization ratio of ethyleneoxide / propylene oxide / allyl glycidyl ether is 70 mol %/24 mol %/6 mol %, and, as for the example 5 of a comparison, number average molecular weight Mn used 750 and an EO-PO-AGE copolymer with number average molecular weight Mn smaller than 10,000. Although this molecular weight was being mixed by the weight ratio 0.25 to the epichlorohydrin rubber which used the small EO-PO-AGE copolymer in the examples 1-4, bleed out was carried out, use was impossible, and since bleeding was intense, an EO-PO-AGE copolymer was not able to measure volume resistivity and compression set, either.
[0058]
[Effect of the Invention] Since the ethyleneoxide-propylene oxide-allyl-glycidyl-ether ternary polymerization object with which number average molecular weight Mn is 10000 or more, and consists of a specific copolymerization ratio is blended to epichlorohydrin rubber in the specific blending ratio of

coal according to this invention so that more clearly than the above explanation, the conductive rubber constituent photo conductor contamination does not have [constituent] compression set in a small top low [a volume resistivity value], either can be obtained.

[0059] Moreover, while it is [bleeding] lifting-hard and carrying out it by mixing within the limits of the above-mentioned convention, there is also no local dispersion of resistance and it can use for various applications as a conductive rubber constituent of low resistance with the practicality which rubber elasticity was given, and physical properties were raised and was not able to be realized in the conventional conductive rubber constituent.

[0060] Thus, a volume resistivity value is low, and since it excels in practicality, specifically, an imprint belt, an imprint roller or the object for colors, the thing for high definition, etc. can be used as a conductive rubber roller and a conductive rubber belt also in a process of which low resistance is required comparatively.

[Translation done.]